

SUPPORT FOR THE AMENDMENT

Support for claim 9 is found on page 10, lines 13-14 of the specification. Support for claim 10 is found on page 10, lines 17-23 of the specification. Support for claim 11 is found on page 11, lines 2-5 of the specification. Support for claim 12 is found on page 22, lines 22-25 of the specification. Support for claim 13 is found on page 23, lines 4-7 of the specification. Support for claim 14 is found on page 17, lines 19-22 of the specification. Support for claim 15 is found on page 17, lines 19-22 of the specification. Support for claim 16 is found on page 22, lines 12-21 of the specification. No new matter would be added to this application by entry of this amendment.

Upon entry of this amendment, claims 1-16 will now be active in this application.

### REQUEST FOR RECONSIDERATION

The claimed invention is directed to a hologram recording material and a process for producing same.

Hologram recording materials are typically valued based on properties of a high refractive index change at the time of recording, a high sensitivity, low scattering, environmental resistance, durability, low dimensional changes and high multiplicity. Issues as to environmental resistance and durability has focused on inorganic matrix materials as well as hybrid materials. Issues with inorganic hybrid matrix materials have focused on the uniformity of film formation, compatibility with the optically active monomer, curing speed and refractive index. Research continues into hologram recording materials having good properties.

The claimed invention addresses this problem by providing a hologram recording material comprising a metal oxide matrix and a photopolymerizable compound, wherein the metal oxide matrix has a halogen-containing organic group. Applicants have discovered that the presence of a halogen-containing organic group in the metal oxide matrix provides a material having a high refractive index, high sensitivity, low scattering, environmental resistance, durability, low dimensional change and high multiplicity. Such a hologram recording material is nowhere disclosed or suggested in the cited references of record.

The rejection of claims 1-8 under 35 U.S.C. §103(a) over Chandross et al. EP 938,027 in view of Loy et al. *Chem Mater*, Shustack et al. U.S. '566 and Hiruma et al. U.S. '831 is respectfully traversed.

None of the cited references of record disclose or suggest the claimed hologram recording material having a halogen-containing organic group nor the improved compatibility between the matrix and the photopolymerizable monomer resulting therefrom.

Chandross et al. EP '027 has been cited for a disclosure of a holographic recording medium based on methyltriethoxysilane, phenyltriethoxysilane, lauryl acrylate and a photoinitiator which is hydrolyzed to form a holographic recording material (examples 1-3). EP '027 corresponds with the disclosure in JP A-11-344917 discussed on page 3, lines 1-18 of applicants' specification. While the reference disclosed an alkyl or aryl group and that the organic components provide compatibility with the organic components (the photoactive monomer), there is no disclosure of a halogen-containing organic group.

Loy et al. has been cited for a disclosure of sol-gels with halogen containing organic groups and that chloromethyl and chlromethylphenyl groups **react more slowly** than methyl, the **pore diameter** of chloromethyl is slightly **larger** than for that of methyl and that hydrogen, methyl and chloromethyl are **more transparent** than ethyl, dodecyl, hexadecyl, octadecyl and vinyl (page 3629, Table 6). The measured transparency is for **that of the gel** its self, and not for a photorecording medium containing a photoactive organic monomer. There is no suggestion that a halogen-containing group would be more transparent than non-halogenated group.

Shustack et al. has been cited for a disclosure that (bromophenyl)trimethoxysilane and (chlorophenyl)trimethoxysilane **lowers scattering losses** in the field of fiber optic communications. The reference discloses at paragraph [0025] that a coupling agent having a high refractive index provides a material with a smooth refractive index gradient between the condensed metal oxide nanoparticles and the somewhat lower refractive index organic portion of the materials, and therefore **lowers scattering loss**. The reference further identifies functionalities of chlorine, bromine, iodine, sulfur, selenium, phosphorus, an aromatic ring or a highly conjugated unsaturated system as proving a high refractive index (pg 3, left column, lines 15-21). Thus, the effect of halogen substitution is expected to lower

scatter loss. There is no suggestion of improved compatability with a photopolymerizable monomer.

Hiruma et al. describes inclusion of a silane coupling agent to a primer layer to improve the bonding power to the support and imparting water resistance to the primer layer. There is no disclosure of improving compatability with a photopolymerizable monomer.

The examiner asserts the obviousness of the claimed combination based on an expectation of improved transparency and increased compatability with the organic matrix.

*No Disclosure of Transparency In Chandross et al.*

The official action asserts motivation to use the halogen substituted organic groups of Loy et al. in the medium of Chandross et al. based on the expected increase in transparency. However, there is no evidence in Chandross et al. of any desire to increase the transparency of the holographic recording material and therefore no motivation to use the halogen substituted organic group of Loy et al. Implicit to the examiner's motivation to use the halogen substituted organic group of Loy et al. in the Chandross et al. medium is a desire to increase the transparency of the holographic recording material. As Chandross et al. fails to describe the desirability of increased transparency, there would be no motivation to make the substitution proposed by the examiner. Why would one of ordinary skill in the art be motivate to increase the transparency of the holographic recording material of Chandross et al. when Chandross et al. fail to describe the desirability of transparency?

*No Motivation To Reduce Scatter Loss In A Holographic Recording Material*

There is no motivation to use a halogen-containing organic group based on an expectation of lower scattering losses. Applicants note that a description of low scatter loss in fiber optic communications does not provide motivation to use such a halogen-containing

organic group in a holographic recording material as the property of scatter loss is not described as desirable in a holographic recording material. What light scattering loss is to be prevented in a holographic recording material? Moreover, the property of low scatter loss does not suggest improved compatability of a metal oxide matrix with a photopolymerizable monomer. Further a higher refractive index is not suggestive of a high **change in** refractive index as is useful in a holographic recoding material.

*No Motivation To Improve the Adhesion of Photocurable Coating To an Underlying Substrate*

The examiner asserts that the disclosed use in Hiruma et al. of a primer layer containing a silane coupling agent to increase the adhesion of a photosensitive layer to an underlying substrate to make obvious the use of such a silane coupling agent in a holographic recording material. As a holographic recording material has **no primer layer** disposed between a photosensitive layer and an underlying substrate, there would be no motivation to us the halogen-substituted organic group of Hiruma et al. in the holographic recording material of Chandross et al. In other terms the properties of a primer layer are not suggestive of use in a metal oxide matrix of a holographic recording material.

As there is no motivation to use the halogen-containing organic groups of the secondary references in the holographic recording material of Chandross et al. the claimed invention would not have been obvious and withdrawal of the rejection under 35 U.S.C. §103(a) is respectfully requested.

*Applicants Have Demonstrated Improved Compatability with A Photopolymerizable Organic Compound*

Moreover, applicants observe a high dynamic range based on diffraction efficiency for the claimed halogen-containing organic group over non-halogen containing organic

groups. The examiner's attention is directed to the data appearing in the specification in example 1 and comparative examples 1 and 2.

Comparative example 1 was formed from tetraethoxysilane (TEOS) and methyltriethoxysilane and a photopolymerizable organic compound as described on pages 24-25 of the specification was added thereto. When applied to a glass substrate **the matrix material separated** from the organic compound and were **not hybridized**. Holographic recording was not permitted.

Comparative example 2 was formed from TEOS and phenyltriethoxysilane and the same photopolymerizable organic compound used in comparative example 1. The resulting holographic recording material demonstrated a dynamic range **M# of only 0.7**, a white cloudiness and a transmittance at 532 nm **decreased by 5%**, relative to example 1.

In contrast, example 1, formed from TEOA and **chloropropyltriethoxysilane** and the same photopolymerizable organic compound used in comparative example 1 demonstrated a dynamic range: **M# of 1.6** and a transmittance at 532 nm which **did not decrease** before and after recording. Thus, by inclusion of a halogen-containing organic group in the metal oxide matrix, applicants observe improvements in a holographic recording material which are not suggested by the cited references.

As the cited combination of references neither discloses or suggest the claimed combination nor the improvements in a holographic recording material resulting therefrom, the claimed invention is not rendered obvious from the cited references and withdrawal of the rejection under 35 U.S.C. §103(a) is respectfully requested.

Applicants submit that this application is now in condition for allowance and early notification of such action is earnestly solicited.

Respectfully submitted,

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